

Initiating and Sustaining Viable Undergraduate Research Programs at Predominantly
Undergraduate Institutions

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While most predominately undergraduate institutions aspire to have vigorous undergraduate research programs, not all have been successful in attaining this goal. Obstacles to engaging the undergraduates in active research programs are many at these emerging research-rich undergraduate institutions. Some of the problems encountered at schools attempting to jumpstart an undergraduate research program include the following items.

1) **Budgeting** – Particularly now, in light of the downturn in the economy, many schools are cutting back on term and part time faculty and are forced to give the tenure track faculty higher teaching loads. A department may increase course offerings and class sizes without increasing the number of faculty. The administrative offices feel forced to cut costs in any way possible, yet still expect new hires to teach full loads (10 – 12 contact hours), contribute service to the college, participate in research, write research proposals, and publish research papers.

2) **Research inactive faculty** - Twenty to thirty years ago, many faculty were hired under the pretense that their major responsibilities would be teaching and college service. In 2003, most colleges and universities are asking that new hires be skilled teachers and productive researchers. Often the newer members of the department are expected to carry the research/proposal writing/publishing load while carrying the same university service and teaching loads as the rest of the department. For the established faculty members who are research inactive, beginning a research program where there is no history of productive research is difficult. Researchers have a difficult time being competitive in obtaining grant support without recent publication.

In addition, heavy teaching loads hinder the ability of any faculty member to establish and maintain a productive undergraduate research program. Faculty members legitimately complain that there are too many demands on their time to adequately supervise a successful research program.^{1, 2}

3) **Inadequate facilities** – Adequate instrumentation is an issue for institutions beginning to focus on undergraduate research programs. Since these schools do not have a record of productive undergraduate research, they often have very little modern instrumentation. Basic instrumentation is even more difficult to justify in a grant proposal when there is little to no undergraduate research that is occurring at present. Without the instrumentation, it is difficult to produce quality research results. Research proposals for shared instrumentation demand novel experiments and significant use of the proposed instrument by a core group of departmental faculty members. Internal funding for instrumentation is often minimal or nonexistent.

4) **Few students participating in research** – Chemistry departments desiring to have a vigorous undergraduate research program often do not have an established system for recruiting students to do research. There must be an adequate number of chemistry students who are interested in participating in ongoing research projects for the faculty to engage them in research.

5) **Not enough emphasis on the undergraduate program within a small department** - Chemistry departments at schools offering advanced degrees in chemistry, albeit to a small population, may overlook the undergraduate students in favor of the handful of students interested

in obtaining a master's degree, or even a doctoral degree. A department may focus on the graduate program and assume the undergraduate program will thrive because of the graduate program even though the majority of students are undergraduates and there are only a few graduate students.

In order to adequately address the above issues, several avenues must be explored. Organizations such as the Council on Undergraduate Research (CUR) address the issue of informing administrative offices of the demands and constraints of producing quality research with undergraduates. College administrative offices must support the research program both rhetorically and financially. This support may include competitive funding for summer student and faculty, additional support staff, laboratory renovations, and undergraduate research program coordination.³ Additional support from the administrative offices may include an internal grants system to support faculty to begin new research projects and enable the faculty to produce results necessary to obtain external funding. Start-up funding and release time for new faculty should be adequate for the initiation and maintenance of a research program for the first few years. In addition, the administrative office may offer incentives such as proposal-writing workshops for faculty interested in improving their writing skills. A recent study showed that between years 1986 and 2001, proposal submission rates and funding rates remained essentially flat, while the faculty sizes have grown more than 21%.⁴ Proposals must be submitted before they are funded.

Teaching load reduction is a primary action cited by most faculty members that would enable them to sustain ongoing undergraduate research projects. Recommendations have been made that faculty not have more than twelve contact hours per week if they are expected to maintain an active research program.¹ Nine hours per week is a more appropriate load if the faculty member is expected to write grant proposals, conduct research, and publish research results in addition to the normal expectations of teaching and service to the institution. It is also helpful, if possible, to schedule a faculty member's classes so that there is an open day during the week that can be used for research purposes.¹

A summer undergraduate research program is essential for a department to sustain productive undergraduate research. The summer programs allow faculty to focus on their work with student researchers in the laboratory and to encourage each other in individual research endeavors. New hires should be aware that they are expected to participate in the summer research program as a requirement for tenure. Faculty participation, however, is not the only essential for the summer research program to thrive. The administration must strongly support the effort. This support may come in the form of offering competitive internal funding for faculty and students, providing housing for summer research students, providing matching money for external grants, or seeking institutional grants for summer support.

The faculty as a whole, as well as the administration, must be committed to the undergraduate research program. Not everyone has to actively participate in the research, but they must support the efforts of those who are research active. Some faculty members may offer to teach heavier loads, allowing research active faculty to have time to devote to proposal writing and laboratory supervision of undergraduate students. New faculty must be equally committed to the research-centered teaching philosophy being nurtured.⁵ Also, faculty should be excited about their research. This enthusiasm is encouraged if the faculty members attend conferences and collaborate with colleagues at neighboring institutions. In addition, faculty members may find it invigorating to conduct research during a sabbatical at a larger university or national laboratory.⁶

For institutions lacking basic modern instrumentation, collaborations are a must for getting a viable undergraduate research program off the ground. Collaborations can also increase the enthusiasm a faculty member has for their research by increasing the communication with a colleague working in the same area.⁶ Other possible avenues include interdepartmental collaborations. Foundation support for such collaborations has increased in recent years.⁷ Once research is underway, novel experiments become easier to justify within a grant proposal. In addition to submitting proposals to funding agencies, other sources of funding for instruments may be investigated. Many colleges and universities have foundation offices that seek donations from outside the college. These offices may be enlisted to help find potential donors for research instrumentation and facilities.

Student recruiting is another area that can be improved at many predominately undergraduate institutions that are trying to initiate an undergraduate research program. Too often departments depend solely upon the admissions staff for student recruiting. This dependence may result in low numbers of chemistry students and even fewer who actually want to participate in undergraduate research. The department must take responsibility for recruiting motivated students interested in chemistry and the prospect of participating in an undergraduate research program.⁵ Faculty must work aggressively with the admissions staff to recruit students who are excited about science and also want the hands on experience that a research program will allow. Summer research programs such as the NSF-REU⁸ program are excellent recruiting tools for departments. It should be noted that students participating in undergraduate research should be offered credit hours or a stipend for their time spent in the laboratory.

Another option to encourage students to participate in undergraduate research that has been pursued by some schools is to make research a requirement for graduation for chemistry majors wanting to graduate with honors from the department. This optional requirement ensures that these students receive experience doing research, making them more marketable on the job circuit, and that faculty have motivated students working in the laboratory.

Small departments offering graduate degrees to a limited number of students in addition to the undergraduate degrees may need to rethink the focus of the department. The department as a whole should decide where they can have the greatest impact in research and what resources are necessary and available to have a successful undergraduate research program. Establishing and maintaining a thriving undergraduate research program requires a focused commitment on the part of the faculty and administration; it cannot be an afterthought or a side project.

The faculty as a whole must take an active role in forming the undergraduate research program into one that is both viable and attractive to students. The research program should indirectly recruit students because of the inherent excitement and valuable experience that it offers. When students witness what a fabulous experience research is for those involved, they are easily convinced to join in on the exploration of a research project.

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